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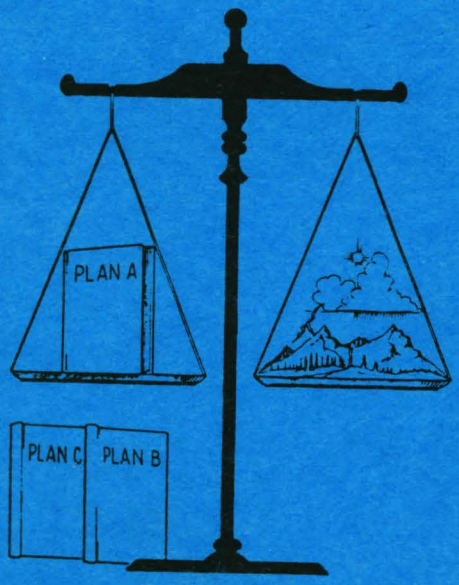
FOCUS

Fire Operational Characteristics Using Simulation



Pacific Southwest Forest and
Range Experiment Station
Forest Fire Laboratory
U.S. Department of Agriculture
Riverside, California 92507

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FOCUS

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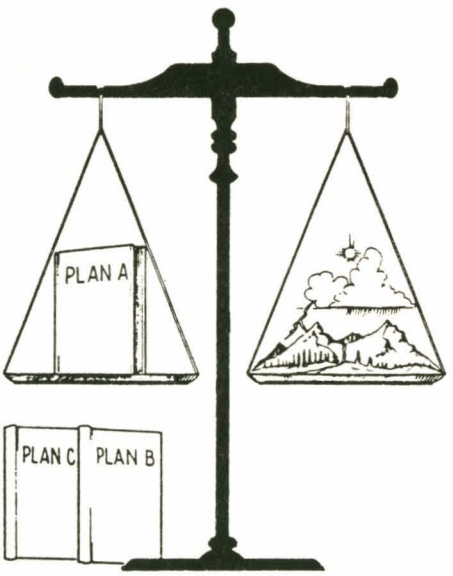

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ABSTRACT

This Guide describes the FOCUS computer system, a simulation model used in long-range fire management planning. It contains a general discussion of six areas: (1) what FOCUS is, (2) who should consider using it, (3) the steps involved in using it, (4) how to interpret the output, (5) how to present results to top management, and (6) the future of FOCUS.

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WHAT FOCUS IS

Overview

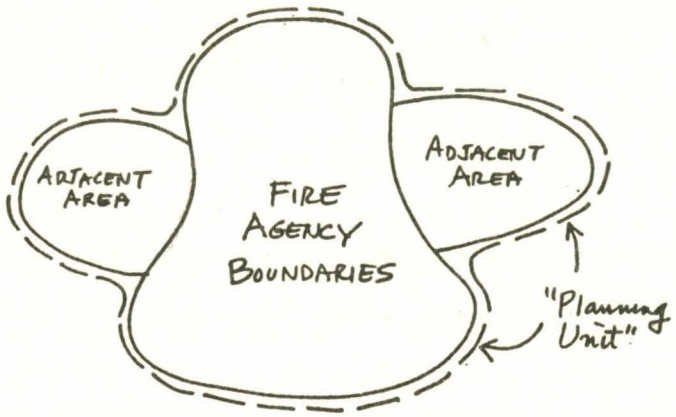
The FOCUS system is a computer-based method of helping fire management planners evaluate alternative long-range plans for the initial attack of fires.

Traditionally, fire management planners combine their experience and judgment with various rules and guidelines to come up with a fire plan that can respond in a cost-effective way to the fire threat. Now, the FOCUS system adds a new dimension to that effort by providing very rapid and objective computer analysis of long-range plan alternatives before costly commitments are made.

Once FOCUS is set up with information describing a planning unit it can test the probable success of many different plans, and it can do this much faster, less expensively and more objectively than manual methods of analysis. Although not operationally tested, FOCUS appears to offer a mechanism for evaluating fuel modification alternatives. By simulating the way in which a given deployment of suppression forces would fight fires that have occurred historically within the planning unit, FOCUS can tell you exactly where every suppression resource is and how it is used, minute-by-minute, throughout the several years of fire history. It can thereby help fire managers condense several years of experience into a few hours.

Within fire protection organizations of all kinds, the purpose of FOCUS is to support overall fire management and land management policies by providing

objective evaluation of long-range plans. A "planning unit" normally consists of a national forest, a BLM region, or a state ranger district, but it need not coincide exactly with the boundaries of one agency. Coordinating agencies can work together in studying their suppression forces so as to minimize overall public costs.

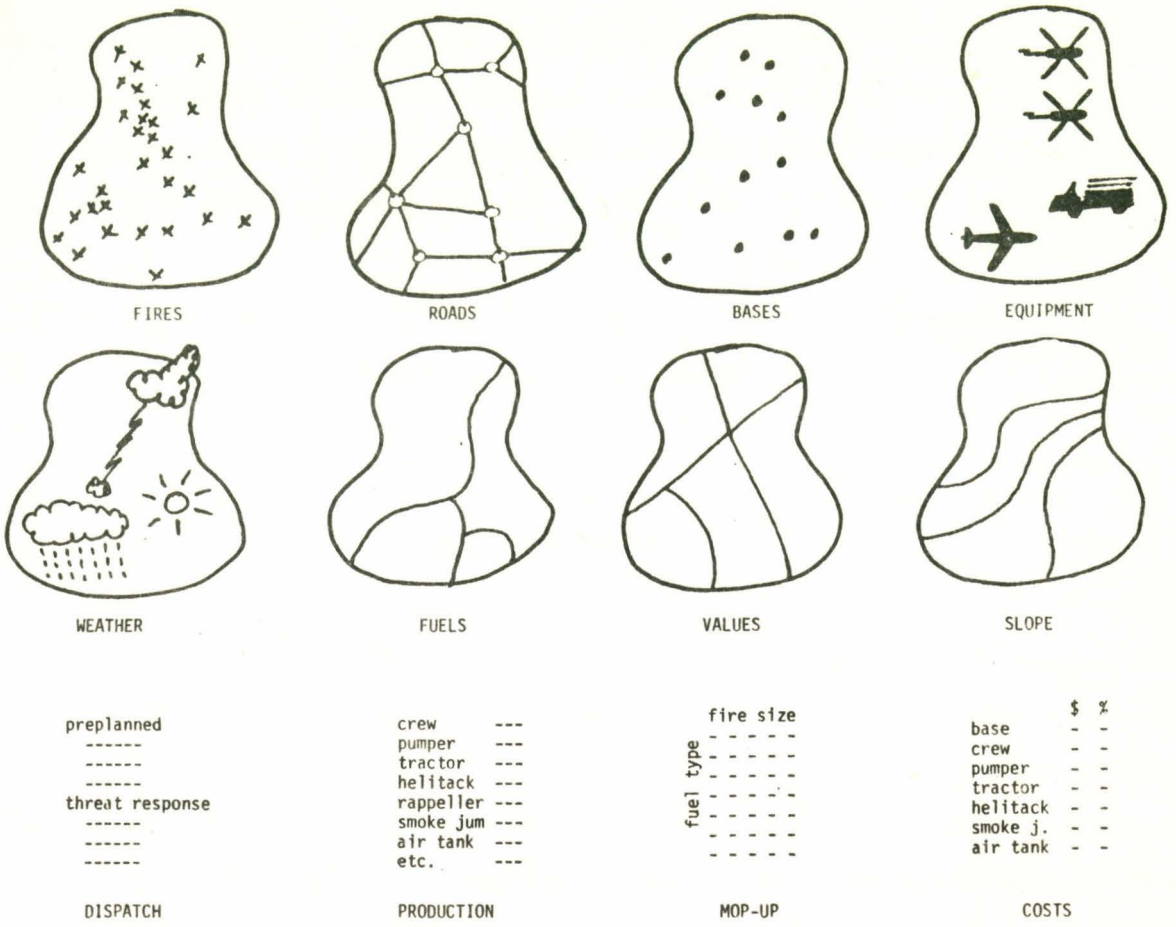


With FOCUS, fire managers, administrators and budget analysts can see the most cost-effective allocation of firefighters and equipment, consistent with land management objectives, available budgets, and resource values at risk. Using reports produced by the system, many of the uncertainties associated with long-range fire planning can be minimized.

How the System Works

The illustration below shows the kinds of information used by FOCUS to simulate your planning unit and alternative plans. This information is gathered and organized on special forms, where each suppression unit such as a hand crew, tractor, or air tanker is represented as a separate entity with specific production rates.

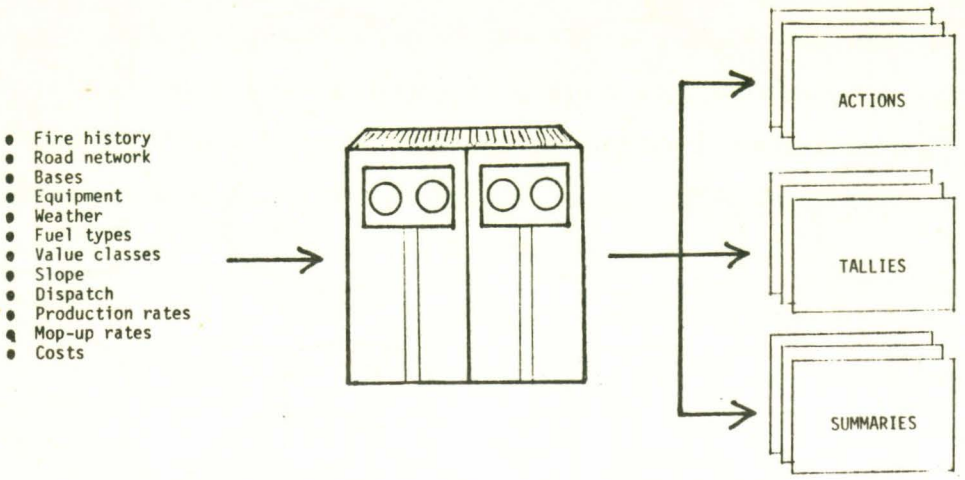
The information is entered through regional computer equipment that is linked by telephone lines to a large computer at Fort Collins, Colorado. Here, the FOCUS programs are run using your data and specifications. The interaction of the suppression units is simulated in great detail as the computer "fights" the list of historical fires you give it.



DATA USED BY FOCUS

The results of this simulation are printed out at the regional centers and are normally available overnight. Several runs can be made and each alternative requires a separate run; after evaluating the results of one alternative, revisions and subsequent runs can be made to test their effects.

The next illustration gives a schematic view of how the system works. Information "inputs" are shown on the left, and processed "outputs" are shown on the right. These outputs consist of reports describing the actions taken to fight each fire, tallies of the equipment and manpower usage, and summaries of overall actions, costs and damages for each alternative plan.



THE FOCUS SYSTEM

Although FOCUS can answer a great many questions, it is not intended to fight a particular fire or a particular day's fires. Rather, it is aimed at helping an agency plan the overall fire management organization that will fight several years' fires. It does not design fire plans, but is used to evaluate alternative plans that you design. It does not develop land management plans. Rather, it shows the impact of such plans on the fire protection job, or conversely, the pattern of fire occurrence that the land use planner must take into consideration. Fuel alternatives and roading decisions can be analyzed with FOCUS, using modified fire history data.

The Benefits

FOCUS has already had an influence on budgets and fire management planning. Some planning units have found that current or proposed capital equipment purchases or manning levels are unnecessary in achieving fire goals. Other planning units find that additional expenditures can be justified by their effectiveness in protecting the values at risk.

The benefits of using FOCUS can be summarized as follows:

- Cost-effective analysis of plans
- Development of contingency or preparedness plans

- Coordination of forces with cooperating agencies
- Testing alternative locations of suppression forces
- Testing alternative dispatching and manning strategies
- Rapid analysis of long-range plans
- Testing alternative fuel type effects
- Testing capital equipment vs. manpower tradeoffs
- Testing use of secondary (non-fire) suppression forces
- Low-cost analysis of "what-if" questions

These are the primary benefits of using FOCUS but there are secondary benefits as well. Perhaps the most significant of these is the process of objective, unbiased analysis, which provides you and your planning team with extensive information on how various alternatives perform. By studying this "feedback" and observing the effects each alternative has, your team can develop a stronger awareness of how the many factors contributing to fire suppression interrelate with each other.

It is this combination of systematic analysis with fire management's experience, skill and judgment that can produce the most cost-effective fire plans.

Limitations

Among the primary limitations of FOCUS is the large time commitment required for start-up. The costs (primarily staff time) of doing this are discussed in the next section and are likely to deter smaller fire organizations. The effort is dependent on team members with skill and patience, particularly in the case of the fire specialist and computer specialist. Extensive data must be collected and validated carefully before any meaningful results can be obtained.

The FOCUS "model" is limited to simulating the initial attack of fires. After fires reach approximately 100 acres in size they are declared "escaped" and must be simulated manually.

Finally, the damage estimates are based on the seven Potential Damage Classes defined by the Forest Service and will not necessarily reflect the true values at risk in a particular area.

WHO SHOULD USE FOCUS?

General Considerations

FOCUS is available for use through the Fort Collins Computer Center to any fire organization throughout the country. National Forests work through their regional FOCUS representatives. Department of Interior agencies work through their Fire Management Office in Washington. States work through the State/Private area representative of the U.S. Forest Service.

The system is particularly useful when you have a strong incentive to examine alternatives to your current base plan and FOCUS is exceptionally good at this. It is important that you have access to records on equipment, manpower, and fire history (approximately 10 years). The data collection effort is the most time-consuming and costly task in using FOCUS.

Planning units should be staffed with or have ready access to a computer specialist skilled in the FORTRAN computer language and capable of working with Univac computers. The FORTRAN language is used in preparing data. It is the responsibility of each planning unit to prepare its data and run its alternatives on the Fort Collins computer. In addition to a computer specialist you should also have access to a high-speed computer terminal either at your own location or at a regional center where it can be used by the computer specialist.

FOCUS is very useful when you have many planning factors to consider. The computer can simulate the interaction of several thousand fires, suppression forces and strategies in far less time than it would take a competent analyst to study only a few such combinations manually.

When budget reductions are anticipated FOCUS can be equally effective. It can show which suppression plans perform most cost-effectively and it can show which pieces of equipment or which suppression force locations contribute least to the overall fire-fighting effort. It can show which elements are the most crucial to the objectives of a fire plan. It can show the consequences of budget reduction in terms of potential resource losses, "escaped" fires, and no-dispatch fires.

A Checklist

Here is a checklist of considerations for fire agencies contemplating the use of FOCUS. The more questions you answer "YES" to, the more seriously you should consider using FOCUS.

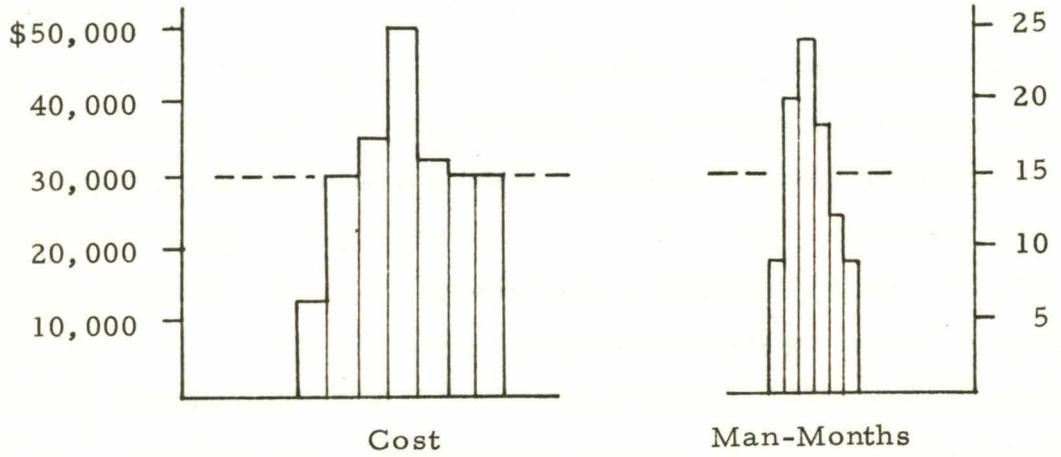
1. Does your region require use of FOCUS for budget or resource changes?
2. Do you anticipate budget changes?
3. Are you beginning a new planning cycle?
4. Are you required to present cost-effectiveness information in your plans?
5. Do you suspect inefficiencies in forces?
6. Do your bases need relocation?
7. Do you want to test innovative techniques and equipment?
8. Do you have difficulty visualizing optimum combinations?
9. Can you obtain the assistance of a computer specialist?
10. Do you have access to the necessary data?
11. Do you want to test new fire suppression policies?

This list does not contain all of the considerations that may apply to your particular circumstances but it does cover major ones that will assist you in recommending an optimal time to begin using the system.

Costs

The start-up cost for a single planning unit (a national forest, BLM region, or state ranger district) has averaged just over $30,000, the large majority of which is in-house staff cost. This is based on a survey of test users and is expected to provide a reasonable estimate for future users, though the actual range of cost for different planning units is likely to vary between $15,000 and $50,000.

This initial cost for the first use of FOCUS within a given planning unit includes a host of "learning curve" considerations, including basic training, familiarization with the methods of data collection and familiarization with how the simulation methods work. It also includes all steps needed to complete a plan analysis, with alternatives, for the planning unit.



EXPERIENCE OF TEST USERS

Personnel costs are the largest portion of these overall costs. An average of about 15 man-months has been experienced, mixed among the fire manager, fire specialist, computer specialist, field technicians, and other staff.

The computer cost of evaluating a "what-if" change in plan against 1,000 fires, after the basic data describing your planning unit is entered into the computer and verified, would be about $100. To run a base plan and five alternatives against four fire seasons would cost $500 to $1,500 in computer time.

Overall personnel and computer costs depend largely on these factors:

- The complexity of factors in the planning unit
- Management's commitment
- The skill and experience of your planning team
- How much time people are given to pursue FOCUS

Once the planning team has been through the "learning curve" associated with the first use of FOCUS, subsequent years' use for the same planning unit will require minimal investments: $500 to $2,500 should cover all personnel and computer costs for updating basic data and testing a few additional alternatives each year.

If the same FOCUS planning team is used to study additional planning units in the same general region, the one-time start-up costs for each additional planning unit would probably be 15% to 30% less costly than the first planning unit studied by the planning team.

While no immediate savings from FOCUS can be expected in your planning period, you should expect increased cost-effectiveness in your operational phase, during which the new suppression organization actually fights fires. There will be new costs to gather data and operate the program during the start-up phase, but the long-range cost savings should be considered as more cost-effective fire plans are put into operation.

IMPLEMENTATION

Staffing

The cost of using FOCUS is related to the skill and patience of your planning team. This is a very important factor. The fire specialist, for example, must be willing to understand the reasons for the computer's output. People with experience and good judgment will make your project go more quickly and smoothly.

It is desirable to have people with experience in using computer models. FOCUS itself is nothing more than a model of how most fires spread, plus an accounting system that keeps track of the details concerning availability and deployment of suppression forces. The better your team understands this type of analysis the more effectively they will be able to use FOCUS.

It is also important that your staff be able to devote substantial amounts of their time to the project during the start-up period. Scheduling of team meetings can be very difficult if members have more than half their time committed elsewhere. In addition, certain tasks such as data collection require full-time attention if they are to be done efficiently.

The list below gives a rough approximation of staff members that will be needed and their approximate percent contribution to the total effort, measured in time:

- Planning unit head — less than 2% of his time
- Fire manager — less than 10% of his time
- Fire specialist — majority to full time
- Computer specialist — less than 25% of his time
- Field technicians, other staff — less than 10% of their time

These estimates assume that you use outside services for keypunching and other data entry services, and they may vary considerably for your particular circumstances. For example, the responsibilities of the fire manager and fire specialist could be performed by one full-time person. The computer specialist may be a planning unit person or part of a region-wide pool.

The fire specialist has several functions that are essential to the success of using FOCUS. First, he will guide the selection of historical fire seasons to be simulated. Second, he will help shape fire management aspects for the alternatives to be studied. Third, he will lead the "gaming" or estimating of large-fire situations which are beyond the scope of FOCUS capability.

The computer specialist should have recent experience in FORTRAN programming. He or she will need to supervise the entry of data, develop small-scale programs for the manipulation of data, control the computer runs, and assist with interpretation of results.

Much of the data collection effort, the largest segment of work in setting up the FOCUS system, is devoted to gathering information on the road and trail network. Field technicians can collect most of this data.

Training

The training period for FOCUS varies for each member of the planning team. Among the primary training considerations are the formal instructions at a regional or state center. The time durations for these instructions are:

	Days
• Fire manager	2
• Fire specialist	5-8
• Computer specialist	3-5

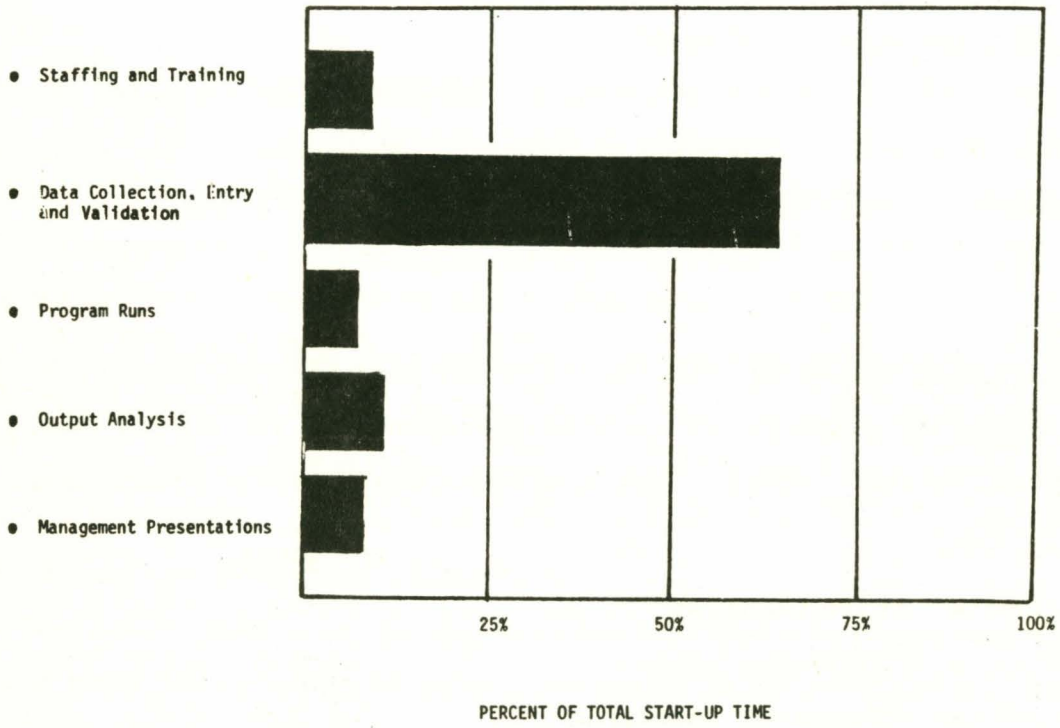
These are actual in-class times and do not include general staff orientation meetings and consultation. In addition, the fire specialist and computer specialist will need to study FOCUS User Manual (approximately 400 pages in length). Considering these factors, the total training for the fire specialist

and computer specialist may run between two and four weeks per person.

Training of field technicians and other staff members is an in-house responsibility guided by the fire manager, fire specialist and computer specialist. About one day per technician should be allocated for this purpose, providing the tasks are defined clearly.

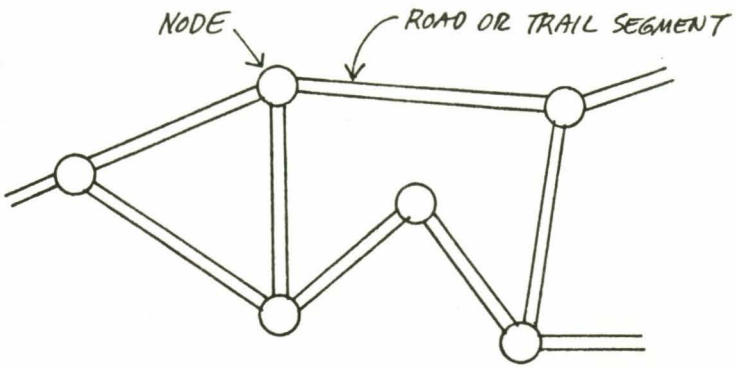
Data Collection

Data collection is the largest single task in setting the planning unit up for FOCUS. The effort is similar to, but not as detailed as, the fire planning effort of 1970-1972 conducted within the United States Forest Service. The chart below illustrates average time commitments for each task.



Transportation network data represents by far the largest portion of work within the data collection effort. Travel speeds are recorded for all aircraft types, and travel times between "nodes" are recorded for three weight classes of vehicles, foot and horse. A node is any arbitrary point on the network. All

intersections and bases are nodes, but nodes may also be located within a road segment to signify a change in slope, a gate, etc. For land travel, times must be recorded in both directions between adjacent nodes. You may also need to prepare node and travel time information for segments of a cooperating agency's network if your planning unit incorporates some of their territory.



DEFINING THE TRANSPORTATION NETWORK

Most fire history data can be compiled from individual fire reports. Magnetic tapes describing weather, topography, and fire danger ratings are available for many areas through the Fort Collins Computer Center. These tapes may be useful to planning units in mountainous terrain.

If production tables for your equipment and manpower, and rate-of-spread tables for fires have not been established for your planning unit, you will need to do this. The FOCUS User Manual will help you with this task.

Procedures and rules of the agency, such as dispatch actions under various conditions, need to be translated into decision tables and entered into the computer prior to the FOCUS run. Dispatching rules describe such things as how secondary forces (e.g., an engineering unit or rural fire department) are utilized, when, on what kind of fires, and how long it takes to dispatch them.

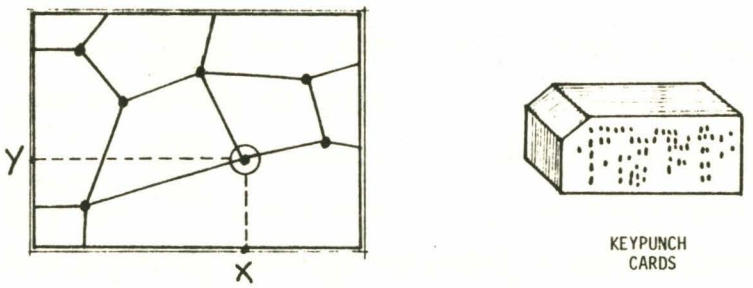
Cost data describing each suppression unit, such as a vehicle, aircraft or crew, is needed, along with the portions of financing assumed in the fire budget. Costs of operating each base are distributed across initial attack, prevention, detection and other accounts such as training.

Data Entry

Once your data is assembled it is entered into the computer. There are two ways of doing this:

- Transportation network data is entered from electronic "digitizing" equipment. This equipment identifies network nodes from a road map by referencing X-Y coordinates at the edge of the map.
- All other data is entered on special data forms that are then used to prepare keypunch cards.

The digitizing and keypunch operations can normally be contracted for on an as-needed basis.



METHODS OF DATA ENTRY

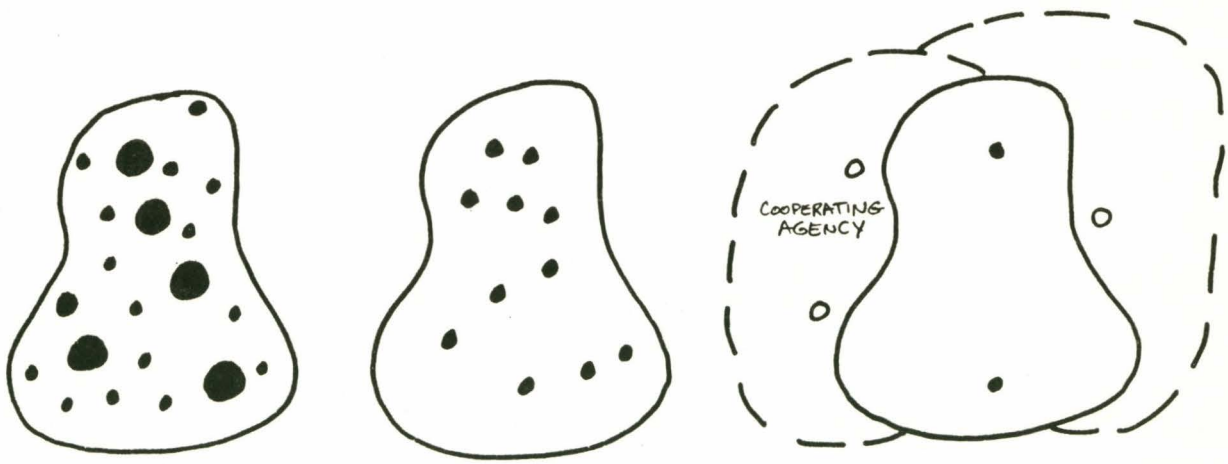
Defining Alternatives

Most fire organizations are quite adaptable to fire threat--small changes will not usually make much difference to overall damages or costs. Substantial

differences normally show up only when alternative plans are dramatically different, and it is therefore necessary to think in terms of big changes. In FOCUS, these changes can be produced by varying such factors as:

- Location and concentration of bases and stations
- Manning and equipment levels
- Suppression objectives
- Dispatching plans and policies
- Mix of primary and secondary forces
- Use of cooperating agency forces
- Boundaries to the planning unit
- Equipment and manpower financing
- Fuels

The illustration below shows just three of many different types of alternatives that could be compared. For example, an "everything-but-the-kitchen-sink" alternative might have heavy coverage by air and land bases, preplanned dispatching, and strong concentrations of forces at each base. A "middle-of-the-road" alternative may rely only on existing forces and base locations. A "sparse" alternative might dramatically cut existing forces and base locations in favor of sharing resources with adjacent cooperating agencies.



DEFINING DISTINCT ALTERNATIVES

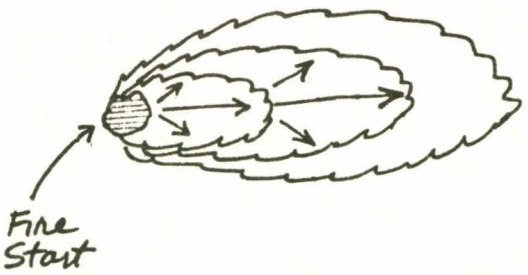
A good set of alternatives requires both careful thought and bold imagination. And it requires more than one attempt. It is rare that you will discover the "best" alternative by simply selecting three for analysis and then choosing the one that results in the lowest cost. You will have to study the manner in which the computer used your assumptions to arrive at the results for each alternative, and in doing this you will very often discover new ways to improve substantially on your original assumptions.

The definition of alternatives, then, is a process you will repeat one or more times after you have run the simulations on the computer. This is discussed further in Section IV, "Interpreting The Results".

Program Runs

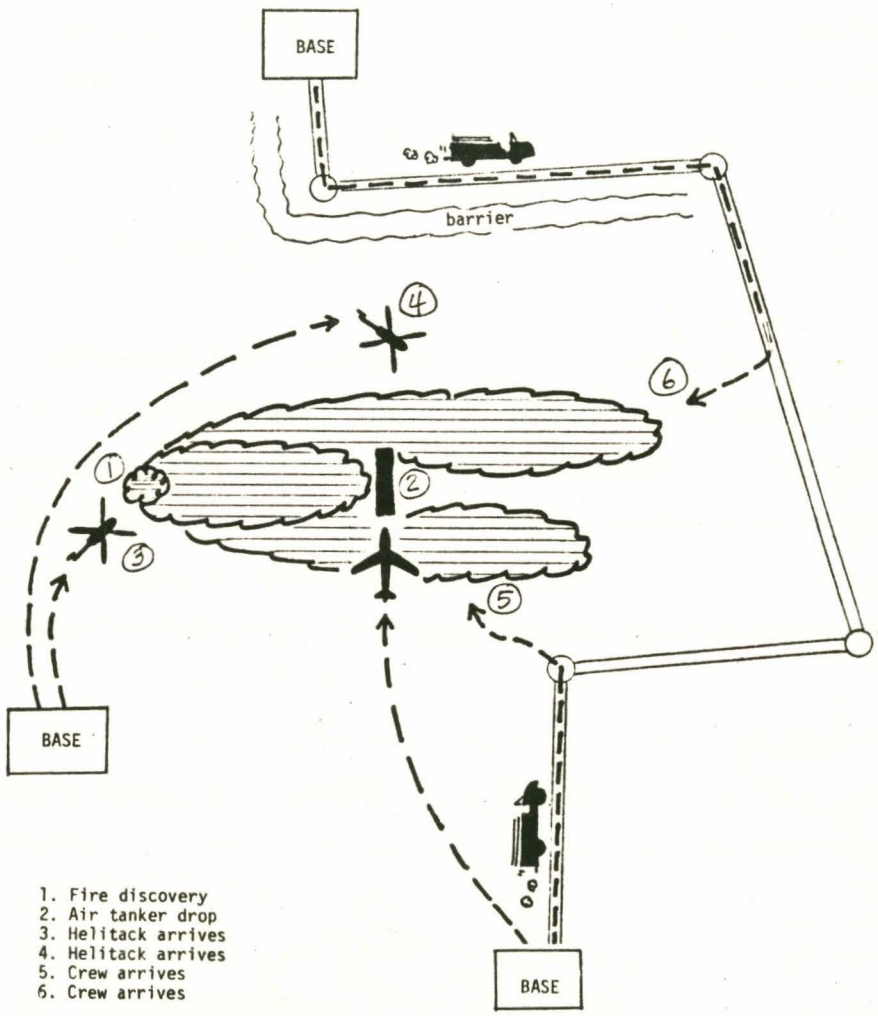
After all of your data is entered and your initial plan alternatives are specified, the FOCUS programs are run on the Fort Collins computer. This is when the simulation takes place. It lasts between several minutes and a few hours, and the results are normally available overnight at regional centers.

FOCUS "fights" individual fires in the following way: First, a fire is "detected" using your historical records of date and time for each fire. The sunrise/sunset times for that day in history are then calculated; if the fire falls between sunset and sunrise, all air attack is excluded; fires after midnight may be attacked by air 30 minutes before sunrise. The date and time are also used, together with your manning level plan, to determine the manning levels at each base.



THE FIRE-SPREAD MODEL

Fires are "spread" in an elliptical pattern using your historical data on rate-of-spread, and this spread is constrained only by the ability of suppression forces to arrive at the location and build line. Your dispatch plan is used to deploy these forces. In preplanned dispatch, where predetermined resources are sent, an objective is set that the computer program tries to satisfy with available forces; if it cannot meet this objective it reverts back to threat response dispatching, where resources are dispatched on the basis of need.



HOW FOCUS FIGHTS A FIRE

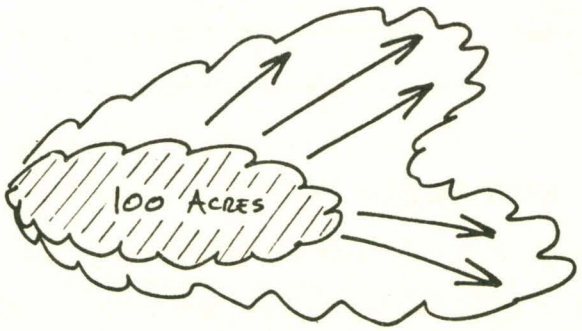
The program generates an arrival sequence for all types of forces, using computer travel times, until (1) the fire is contained, (2) the fire exceeds the "escape" size, or (3) the forces are used up. As crews arrive they are placed on the fire line in either a head, indirect head, or flank attack, according to your specifications. Calculations of spread rate, perimeter size, and line production rate are performed by the program. The production rate used for each crew or piece of equipment is a function of the fuel type and slope, which are part of your data input. Rate-of-spread is based on the historical event.

The illustration above shows how FOCUS might attack a fire, considering the various factors we described so far. Once the fire is contained or escapes, its size is compared with the damage potential class to determine the value of losses. The suppression forces needed to mop up the fire remain on the scene as long as needed, then they return to their base to become available for other fires.

You should not expect the simulations to be 100% representations of how you yourself would manage a particular fire. This would be far too complex a computer system. Fire managers are able to consider many more factors, particularly judgmental factors, than the computer. Nevertheless, you will find the computer a very challenging assistant, able to respond rapidly with answers that have been computed systematically according to your criteria.

Escaped-Fire Gaming

"Escaped" fires are those which exceed some predefined acreage, such as 100 acres, which you can specify.



AN ESCAPED FIRE

The simulation process stops when a fire reaches the escape size and your planning team is called in to determine the final outcome, suppression costs, and resource damages of the escaped fire. This is done because it is felt that the FOCUS model would not simulate reality as accurately as you could on large fires. FOCUS's basic elliptical-spread model for fires may not be appropriate on large fires where the interplay of weather, fuels, topography, and other factors will usually produce erratic spreading. Moreover, in an escape situation you may want to vary your dispatching rules considerably.

During the "gaming" of an escaped fire you will be given information about forces at the fire and on the way, the amount of line built and holding, and the weather forecast. It is then up to you to make the moves.

Your estimates of costs and damages must be added to the FOCUS output for overall cost and damage totals.

General Considerations and Limitations

It is best to start slowly with your work on FOCUS. Allow your team adequate time to absorb their training and do the necessary background reading and study. Organize the data collection task carefully, making sure you know where your information will come from, in what form, and how it will all fit together in the manner required for entry into the computer. It is important to obtain the correct data and use the correct format.

Some information such as travel times along road segments can be collected piecemeal, but only if it is carefully managed to maintain consistency. Other information, such as going through individual fire reports, is best collected in a single concentrated task.

Data collection, as we have emphasized before, is the most time-consuming task and you will probably encounter some frustration in getting through this phase. While your data need not be perfect, it must be relatively accurate and entirely consistent in format.

FOCUS does not solve fire problems. Rather, it provides data for analysis of the alternatives that you design. The better you understand how the

model works, the better you will be able to design potentially successful alternatives.

One final point: the simulation routines of FOCUS imitate the workings of "perfect" organizations. FOCUS crews have no broken legs, no one gets lost, they are all well trained, no aircraft are shut down for unforeseen maintenance, and no lost-time accidents occur. FOCUS also assumes flawless management performance. These assumptions will result in simulated performance that is better than its real-life counterpart. While there is consistency in the sense that each alternative you test is subject to the same assumptions, you will need to take the assumptions into consideration when adopting a plan designed with the aid of FOCUS.

Support Services

Support of FOCUS users will be officially assumed by National Forest Systems (Aviation and Fire Management) in Washington, D.C., beginning in October, 1977. They will be responsible for updating programs and documentation. Before this time, and for approximately a two-year transition period after this date, the FOCUS system development team (Forest Service Research) in Riverside, California, will assist in support.

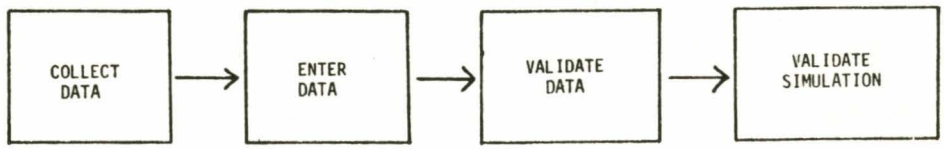
The first training workshop will begin in Winter 1977-78 at Fort Collins, Colorado, under the auspices of National Forest Systems. The interagency National Wildlife Coordinating Group training team will prepare a FOCUS training handbook by 1981. Meanwhile, agencies will need to cooperate in providing training services.

Currently available documentation on FOCUS includes: (1) the Executive Brochure, (2) the 400-page User Manual, (3) the Forms Guide for entering data, (4) the program documentation for support staff use, and (5) the documentation control system for support staff use.

INTERPRETING THE RESULTS

Validation of Output

After you collect and enter your data a truth-checking or "validation" step is made. In effect, this is a procedure to see that the simulation model understands your data correctly and that you understand the simulation model.



Validation is done in two steps: first, your data is validated before running the simulation model, and second, a limited run of the simulation model is made using only a small portion of the historical fires you intend to use.

The first step (validate data) uses edit routes to check your data for accuracy, consistency, and conformance to the requirements of the FOCUS programs. It will more than likely turn up several discrepancies caused by a variety of human errors during the data collection phase.

The second step (validate simulation) covers all operational rules you have given the computer, including dispatching rules, manning rules, use of secondary resources, and so on. It is done by running a limited number of historical fires against your current base plan. It is important to fully test the Base Plan for errors prior to running additional alternatives. The process involves reviewing two types of computer reports: (1) the "fire parameters" for each

fire, which list the sequence of actions taken to fight each fire, and (2) the "use tally" for equipment and crews at each base during each fire season. This task is usually more difficult than data validation. You will need to assure yourself that the FOCUS model is doing a reasonable job of deploying resources and fighting fires that you may have personally managed recently. This is best done as a team effort with two or more men who know the planning unit's problems.

```
**** FIRE PARAMETERS   FIRE NO.   36   FIRE TYPE - WILDLAND, FOREST
FIRE  FIRE   FIRE     FIRE  X-LOC  Y-LOC  INIT. FUEL SLOPE ADJ FOR   HDP  FORWARD  LATRL  ATTACK  SPEC. MANN.  DISP  SEC
YDAY  TIME   LAT.     LONG.  CHAINS CHAINS  ACRES TYPE CLASS CLASS CLASS H.O.S.  R.O.S.  FROM    1  2  3     AREA  NET
1197  1130  46.122  113.820  -1233   1061    .00  23    8     3     4     6.00    3.00   REAR    0  0  0        0    4
RESOURCE TYPES EXCLUDED FROM PERCREW =
RESOURCE ARRIVAL SEQUENCE
  TIME      RESOURCE        BASE      UNIT      UNIT SIZE
 (MIN.)       TYPE         NUMBER    NUMBER     OR TYPE
   41    AIRTANKER           1         2       DROPLNTH  5.5 CM.
   46    AIRTANKER           1         2       DROPLNTH  5.5 CM.
   65    HELITAK CREW        4         1         2 MEN
   70    HELITAK CREW        2         2         2 MEN
  110    SMOKEJUMPERS        1         1         6 MEN
  113    AIRTANKER           1         2       DROPLNTH  5.5 CM.
  118    AIRTANKER           1         2       DROPLNTH  5.5 CM.
  121    MANDCREW            2         1        17 MEN
  121    MANDCREW            2         2         2 MEN
  124    MANDCREW            1         1         4 MEN
  124    MANDCREW            1         2         3 MEN
  131    MANDCREW            8         1         4 MEN
  131    MANDCREW            8         2         4 MEN
  131    MANDCREW            8         3         6 MEN
  134    MANDCREW            1         3         1 MEN
  134    MANDCREW            1         4         1 MEN
  144    HELITAK CREW        3         1         2 MEN
  149    HELITAK CREW        3         2         2 MEN
  175    AIRTANKER           1         2       DROPLNTH  5.5 CM.
  179    MANDCREW            7         1         7 MEN
  200    MANDCREW           10         2         2 MEN
  203    HELITAK CREW        3         1         2 MEN
  205    MANDCREW           10         2         2 MEN
FIRE CONTAINED AT  224 MINUTES AFTER REPORTED. BURNED AREA WAS  3.592 ACRES.
```

ACTIONS TAKEN

The primary validation method is to compare your fire organization's experience with the FOCUS-simulated results for a given year in the past.

GROUND UNIT USE TALLY
(NUMBER OF DISPATCHES PER UNIT ON EACH BASE)

BASE #	UNIT NUMBER 1	2	3	4	5	6	7	8	9	10
1	3									
2	5	0								
3	2	0	0							
4	0									
5	1									
6	1	2								
7	0	0								
8	0	3								
9	0									
10	0									
11	0	0	0	0						
12	0									
13	0									
14	0									
15	0									
16	0									
17	0									
18	0									
19	0									
20	0									

TALLIES OF USE

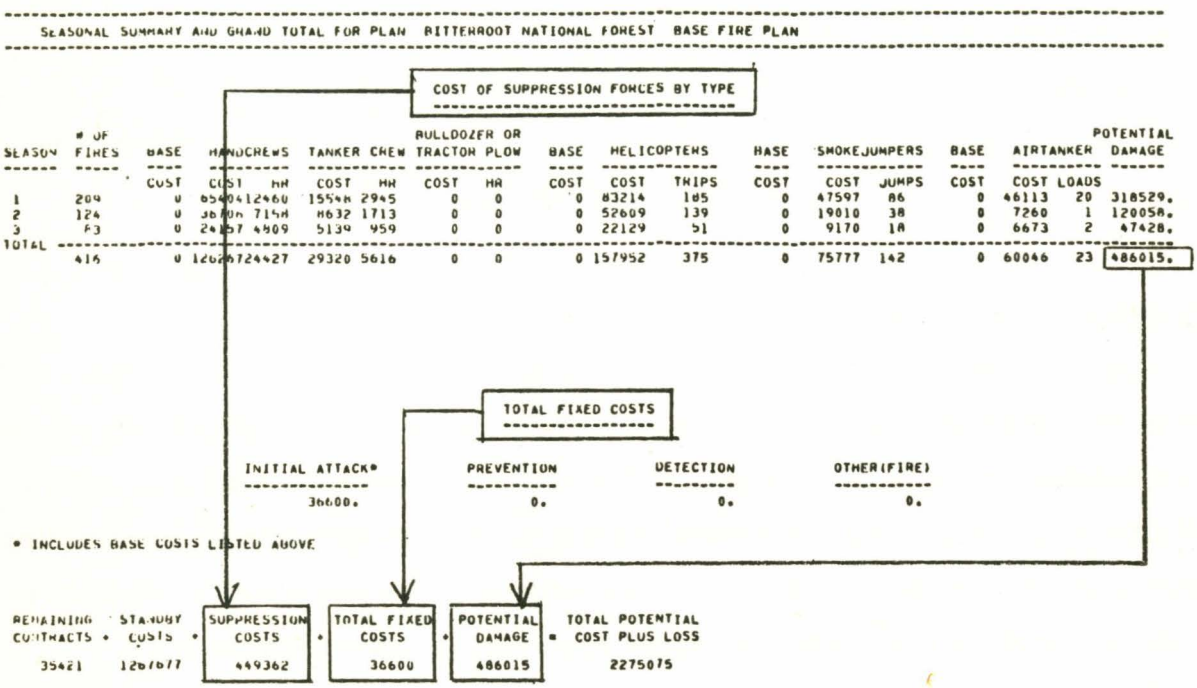
Adjusting Alternatives

Once the two validation steps are completed you can go on to a full-scale run of the alternatives. Normally, it is best to begin with one or two alternatives before taking on all of them. There are two reasons for this: (1) you will probably need minor additional adjustments on your data or dispatching rules to get the model to behave as you expect it to, and (2) an in-depth review of one alternative may generate ideas for shaping other alternatives.

To determine what your suppression organization is capable of, it is important to find its failure point without employing secondary fire resources. After the primary-force failure point is established you can relocate them, increase the manning, change the dispatch rules, or add secondary forces. In a similar way you can evaluate the optimum capabilities of ground crews or pumper units by reducing or removing other complementary forces such as air tankers. This kind of tinkering with FOCUS will not only bring your experience of the real world into closer touch with the computer's ability to handle details very rapidly and systematically but it will also help you discover the most effective use of your suppression forces and locations.

Measuring Cost and Loss

The illustration below shows a "seasonal summary" report for a plan alternative. One such report is received for each alternative plan you run. The several columns near the top entitled "Cost of Suppression Forces By Type" itemize for each fire season the base costs, suppression unit costs, and potential damages. These suppression costs are then totaled at the bottom of the report.



SEASONAL SUMMARY AND GRAND TOTAL FOR PLAN BITTERROOT NATIONAL FOREST BASE FIRE PLAN

COST OF SUPPRESSION FORCES BY TYPE

SEASON	# OF FIRES	HANDCREWS BASE	HANDCREWS COST	HANDCREWS MH	TANKER CREW COST	TANKER CREW MH	BULLDOZER OR TRACTOR PLOW COST	BULLDOZER OR TRACTOR PLOW MH	HELICOPTERS BASE	HELICOPTERS COST	HELICOPTERS TRIPS	SMOKEJUMPERS BASE	SMOKEJUMPERS COST	SMOKEJUMPERS JUMPS	AIRTANKER BASE	AIRTANKER COST	AIRTANKER LOADS	POTENTIAL DAMAGE
1	209	0	65	12460	15548	2945	0	0	0	83214	185	0	47597	86	0	46113	20	318529.
2	124	0	36	7158	8632	1713	0	0	0	52609	139	0	19010	38	0	7260	1	120058.
3	83	0	24	4809	5139	959	0	0	0	22129	51	0	9170	18	0	6673	2	47428.
TOTAL	416	0	126	24427	29320	5616	0	0	0	157952	375	0	75777	142	0	60046	23	486015.

TOTAL FIXED COSTS

INITIAL ATTACK*	PREVENTION	DETECTION	OTHER(FIRE)
36600.	0.	0.	0.

* INCLUDES BASE COSTS LISTED ABOVE

REMAINING CONTRACTS	STANDBY COSTS	SUPPRESSION COSTS	TOTAL FIXED COSTS	POTENTIAL DAMAGE	TOTAL POTENTIAL COST PLUS LOSS
35421	126077	449362	36600	486015	2275075

SUMMARY FOR THREE SEASONS

Potential damages are summed for each fire season. Each fire is assigned a damage class by the user representing dollar value per acre. Up to seven damage classes may be used, with a positive or negative dollar value for each class.

Just below the middle of the report is "Total Fixed Costs", which is broken down into "initial attack", "prevention", "detection", and "other". These four

groups are determined according to a percentage-of-use formula for each base which you define at the beginning of the runs. The costs and losses from large-fire gaming must be added manually to these summaries for overall totals.

The bottom lines of the seasonal summary report show how an overall cost plus loss amount is derived from its components. This information can be interpreted in at least two ways: (1) it can be used literally to compare one alternative to another on the basis of total cost plus loss, or (2) the figures for various alternatives can be compared to the costs and losses of the current base plan to derive differences from the base plan.

The table below shows a "cost plus loss" comparison, where total cost plus loss is compared for each alternative. To some managers, the lowest overall total would represent the best alternative.

COST PLUS LOSS COMPARISON
($ Millions)

Alternative	Cost	Loss	Total
A	3.083	.153	3.236
B	1.862	.461	2.323
C	1.031	.654	1.685
D	.625	.955	1.580
E	.740	.802	1.542

The next table shows a "differences" comparison, where the difference from the current base plan's costs and damages are compared to each of the other alternatives. This is a form of benefit-cost analysis, where the loss (or benefit) difference can be compared with the cost (or savings) difference. It can give you a feel for where the biggest decreases can be made in damages for the smallest additional cost; or conversely, where the smallest increases in damage would result from the largest reductions in cost.

DIFFERENCE COMPARISON
($ Millions)

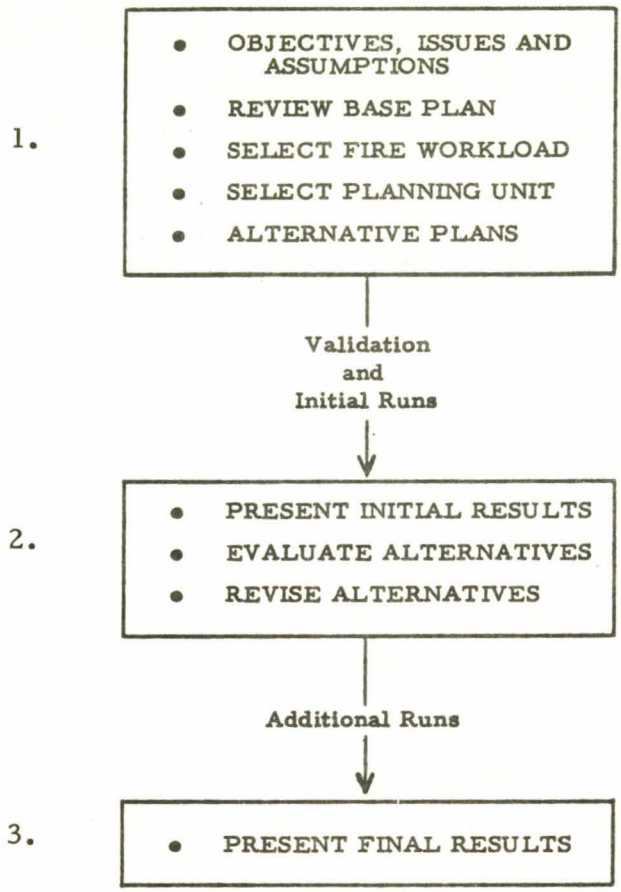
Alternative	Cost			Loss		
	$	$ Difference	% Difference	$	$ Difference	% Difference
A	3.083	+1.221	+66%	.153	-.308	- 67%
B (Base)	1.862	0	0	.461	0	0
C	1.031	- .831	-45%	.654	+.193	+ 42%
D	.625	-1.237	-66%	.955	+.494	+107%
E	.740	-1.122	-60%	.802	+.341	+ 74%

PRESENTATIONS TO MANAGEMENT

Presentation Events

The manner in which you summarize and display the output from FOCUS is crucial. The system can be a tremendous aid to managers and planners, but only if the results are understood by them. Top management (such as a Regional Forester, state BLM Director, or National Forest Supervisor) will have far less time to understand FOCUS's output than the team members who are working with it on a day-to-day basis, so the summaries must be very clear. They must be as free as possible from jargon peculiar to FOCUS and the information you show must have some direct bearing on issues that they, as managers or planners, will be faced with.

Your major meetings with top management will probably come in approximately three events. The first meeting is for initial planning. A variety of topics will be discussed, including objectives, base plan review, historical fire workload selection, planning unit selection, and alternative plans. This first meeting will be the least structured in terms of formal presentations. It should have a pooling-of-the-minds format in which many sides of the issues are discussed. Many of the issues will not be decided at this meeting but will require further information gathering for final decisions. However, it is important that issues be clearly drawn and documented. Agreement on objectives, for example, is especially important. The success of different alternatives in different parts of the planning unit will be measured against these objectives. The establishment of individual or cumulative fire losses may be an important objective for your planning unit.



The second event includes the presentation of initial FOCUS results. These results should include a base plan (which you probably are already operating with) and a few additional alternatives. In the following section we show a series of illustrations on how the results can be translated into graphic terms for a clear, concise presentation to management. It is important to reach some agreement at this meeting on how alternative plans may be changed, what new ones are to be added, and what constraints should be observed in the further design and testing of alternatives.

The third event is generally like the second. If the new alternatives are acceptable, one of them can be selected for implementation. If more work needs to be done, another pass through the second stage can be made.

Examples

The illustrations that follow show how fire plan alternatives might be summarized for a presentation to management. The maps can be drawn on overlay sheets, directly over topographic maps that are large enough to see in a meeting room. They need not be elaborate. Simple hand sketches are often the quickest, most practical way of presenting the information. Color-coding can be added to your maps by using broad-tip felt markers. The sketches of air tankers, smoke jumpers, helitack units and rappellers can take on almost any symbolic form.

Each alternative should be accompanied by a short (one page or less) typewritten handout showing key assumptions and results. This handout should also include a short statement describing how well the alternative fits land management objectives and what the tradeoffs are. For example, alternative "D" in these illustrations might be accompanied by a list of items as follows:

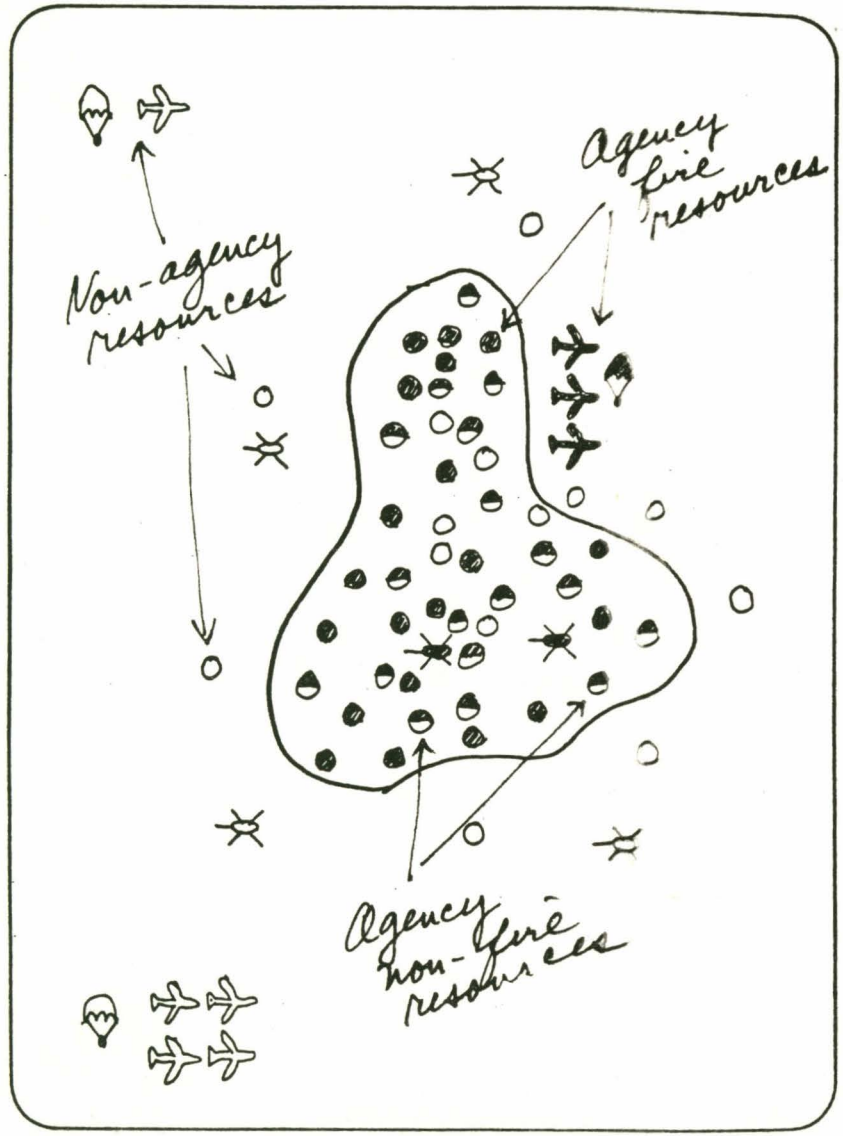
Alternative "D"

1. Heavy reliance on secondary crews from engineering, timber and recreation.
2. Secondary crews handled 23% of fire workload.
3. Assumes 10% of fixed cost for secondary smoke jumper (six men).
4. Assumes 15% of fixed cost for secondary air tankers.
5. Assumes 10% of fixed cost for secondary helitack (six men).
6. Good preparedness plan but severe impact on engineering, timber and recreation projects.

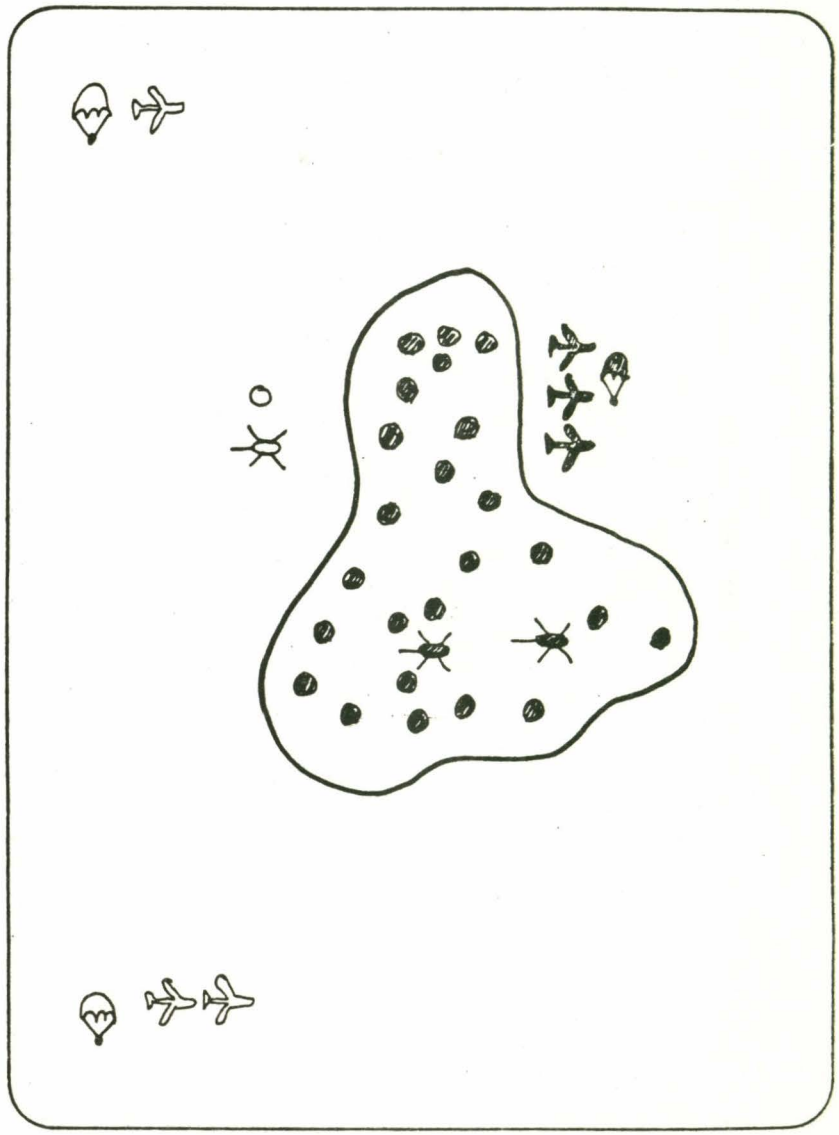
Without this information the maps themselves may not communicate the full distinctions between alternatives, particularly in costs and effectiveness. Management may also want other information pertaining to acreage burnt, "escape" fires for each alternative, cost breakdowns on equipment and forces, justifications for each base, or any number of other points. One way to determine this is to ask them what they want to see before the presentation. However, many questions will arise during the presentation that require an under-

standing of why each alternative performs as it does. There is a need for documenting your observations about the performance of each alternative, but this need is primarily related to the detailed work of the fire specialist and computer specialist so that they can easily pick up from where they left off at a later time. For decision-makers, however, this documentation is likely to be too detailed and would burden them with too much material.

It is important to remember that top management will not be nearly as familiar with the terms, procedures, and outputs of FOCUS as you will be. Therefore, the closer you can come to presenting results in their "language", the more successful the presentations will be. Most people who make the effort discover that computer models are not mystical and can be understood. But the enthusiasm of making this discovery should not lead you to adopt the language of FOCUS, with its unique terms for data and procedures, when making your presentations to management. They will be much more interested in the bottom-line implications and tradeoffs posed by each alternative. They will be thinking about how each alternative will affect other non-fire components that they are responsible for. The more you can help them with those decisions the greater your contribution to the entire land management effort will be.

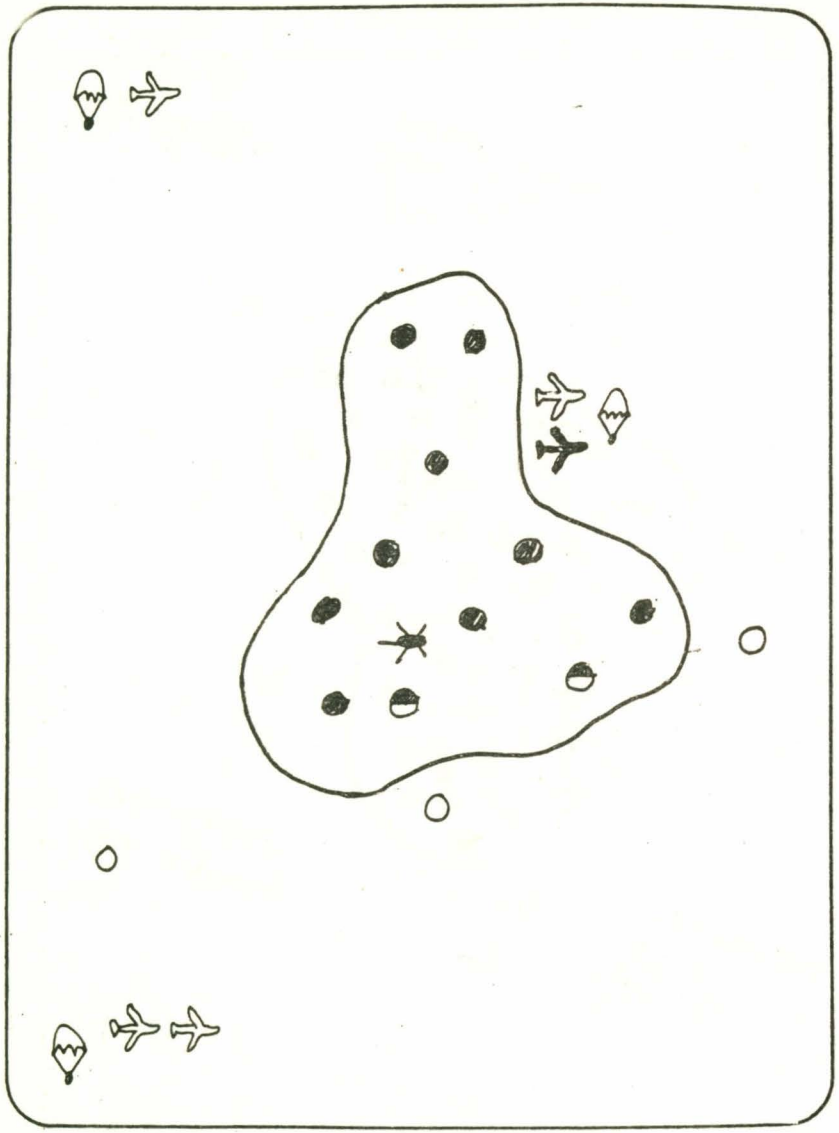


ALTERNATIVE A

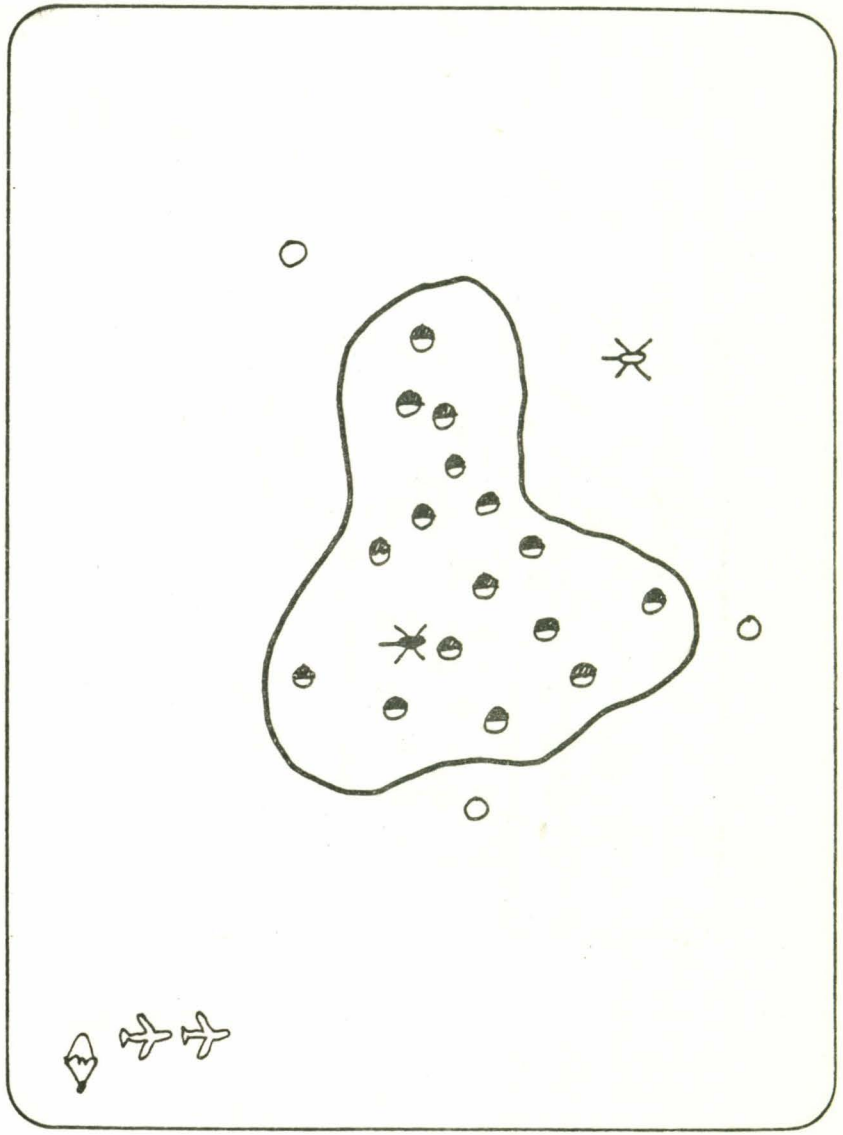


ALTERNATIVE B

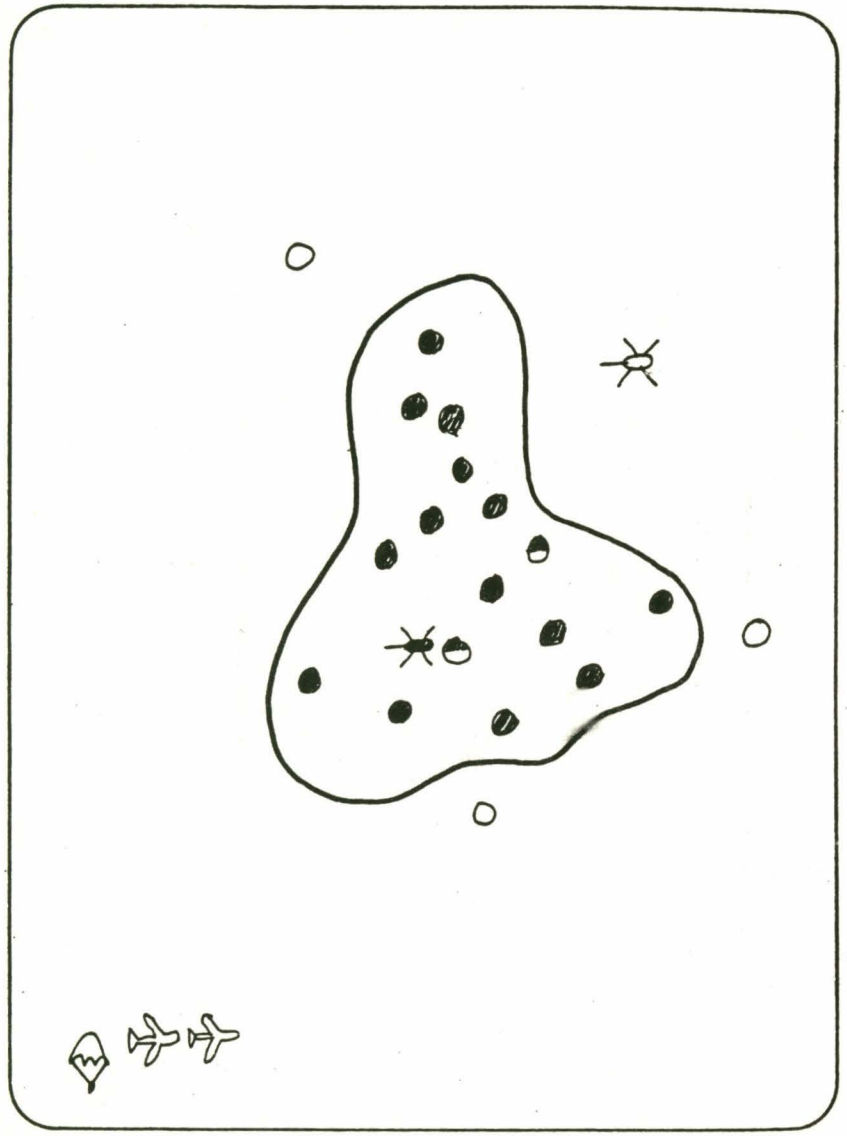
(Base Plan)



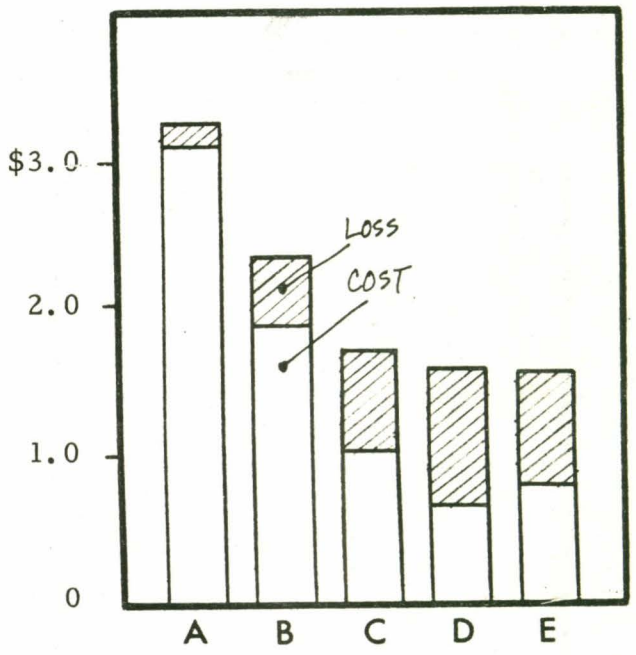
ALTERNATIVE C



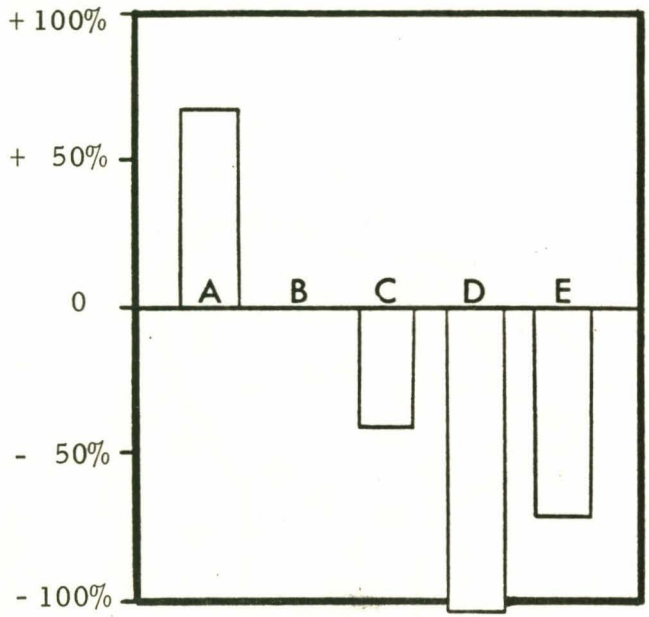
ALTERNATIVE D



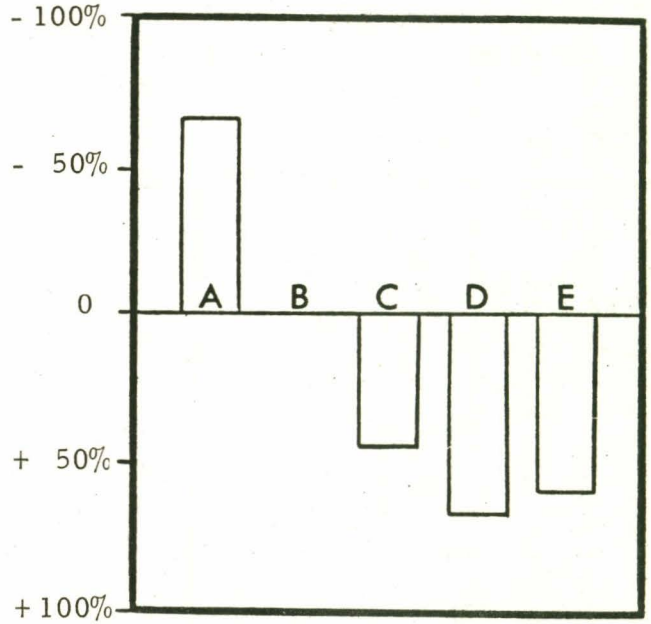
ALTERNATIVE E



COST PLUS LOSS
($ Millions)



DIFFERENCE IN COST
(% Difference from Base Plan "B")



DIFFERENCE IN LOSS
(% Difference from Base Plan "B")

THE FUTURE OF FOCUS

New Applications

At least four new applications for the FOCUS simulation model are possible. The first two are planned for implementation over the next few years, the last two are not yet part of any development plan.

- Prevention
- Values at Risk
- Detection
- Safety

The "prevention" application will allow you to examine alternative risk and hazard reduction methods and to test their effects on fire starts and total cost. It will allow fires to be generated randomly during the day or night, rather than on a strictly historical basis. With it, you will be able to simulate the effects of prevention patrolmen, fuel modification, and the like. Operational testing will begin about 1979.

The "values at risk" application will let you assign a broader range of economic value classes to the resources being protected. You will be able to assign positive or negative values to specific areas under varying conditions such as fire intensity, land use, time of day, or season. Operational testing will begin sometime after 1980.

A "detection" application would allow you to examine effects of various detection units such as towers, air patrols, and citizen reporting. The speed with which fires are discovered could significantly affect your location of forces

as well as your overall costs and losses.

A "safety" application would allow you to apply coefficients (i.e., injury rates for given types of line production resources) to each alternative being tested. This would give you a means of comparing the safest as well as the cheapest alternative plans.

Land Use Applications

FOCUS is designed to contribute to the overall land management effort. It is doing this now by providing a fast, systematic means of evaluating the implications of organizing and deploying suppression forces. As new modules are added in the future FOCUS will do even more.

Currently, FOCUS does not predict the effects of entirely new uses or allocations of land within a planning unit. This is because the system operates from historical fire records. For example, if it were decided that an area currently producing timber be converted to recreation use, with new public roads and facilities, a new problem would arise: the historical records of fire in that area would no longer reflect the expected fire activity because new causes of fire as well as new access routes for suppression would change the pattern of fires.

The current method of handling this problem relies on your judgment of a "similar" land use which can serve as a substitute source for historical fire records. You would select an area similar in size, use, road access, climate, fuel type, and surrounding socioeconomic population. Then you would substitute those fire records in place of your historical records for that area of the planning unit.

Admittedly this provides only a rough approximation of the new fire threat. But this approximation is likely to result in a more systematic and accurate total of overall suppression cost than most manual methods would provide.

Perhaps the most important use of FOCUS is in tying fire management planning to overall land use planning. Fire protection is a real cost and its impact on final land outputs continues to grow. Almost every land management

action has some influence on the fire problem and we see few land management plans that can be brought to completion in the absence of an adequate level of fire protection. FOCUS provides an opportunity to contribute to environmental, economic, and political decisions -- particularly to activities that result in transportation system and fuel modifications. With it, the consequences of alternative action can be spelled out in terms of public tax dollars.

Fire Management Systems (FOCUS) Project Staff.
1977. Fire managers guide for FOCUS. USDA Forest Service, Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

This Guide describes the FOCUS computer system, a simulation model used in long-range fire management planning. It contains a general discussion of six areas: (1) what FOCUS is, (2) who should consider using it, (3) the steps involved in using it, (4) how to interpretet the output, (5) how to present results to top management, and (6) the future of FOCUS.

Keywords: Simulation, fire planning, FOCUS, computer, initial attack, benefit-cost ratios, evaluation, cost-plus-loss.

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